

Designer Circuits

SIGNAL INJECTOR - TRACER

There are two extremely useful pieces of test gear for both the serviceman and the amateur constructor. These are a signal source and a signal tracer.

Faced with a transistor radio that doesn't work, what do you do? It is important that a logical approach is taken and although this may sound obvious, it is very, very easy to become diverted.

First check that the battery is not flat (for this accounts for about 50% of so called faults) and then check that a good contact is being made on the cut-out switch of the earpiece socket if one is fitted. Always check these first but assuming there is still no joy what do you do?

The volume control is easily located, contacts can generally be made to it quickly and it is an excellent place to start.

If you inject a signal of the slider of the volume control and it is heard at a decent level from the loudspeaker you can be fairly sure that nothing is wrong with the amplifier. If nothing is heard there is obviously something wrong and the field is immediately narrowed.

Assuming that the audio stage is working you can then inject and IF signal at the collector of the mixer stage — the same rules apply as before.

Alternatively you can take the 'signal detect' approach. If instead of injecting a signal at the volume control you can listen at the same point to establish that the radio is working satisfactorily up to a certain point.

The above is a super concise lesson in fault finding but it does illustrate the tremendous use that a signal injector and a signal tracer can be put to.

The project described here is for a combined device — it can inject signals at RF IF and audio and can detect signals at the same frequencies assuming that they are high enough in level. The simplicity of circuit may lead you to doubt this claim but it does do all this.

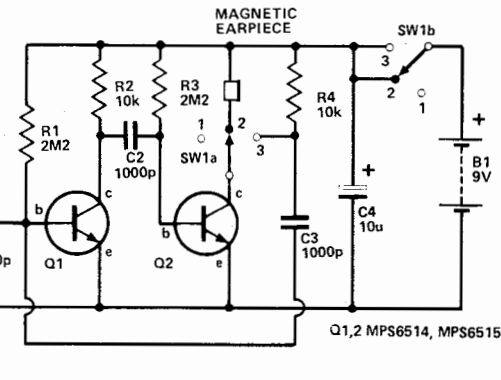
The function switch, SW1, has

- No. 1 Off position
- No. 2 Trace Position
- No. 3 Inject Position

Position 1 merely disconnects the supply and the device is of course inoperative. As shown the function switch is in position 2 and in the trace mode.

One of the contacts is the common line and should be wired using a crocodile clip to the chassis of the equipment being investigated. The other connection is the probe.

This goes via DC blocking capacitor C1 whose working vol-



tage should be high — if a 500 V working component is used the circuit can be used on valved equipment working at high voltages.

The signal is fed to Q1 which is arranged as a common emitter amplifier but which is biased nearly to cut-off which creates deliberate distortion at the same time as amplifying the signal. Distortion in such a manner leads to the detection of RF signals and so whatever the frequency fed in, assuming it is modulated, and audio output will be heard. The collector load of Q1 is R2 and the output of this stage is fed to a further one of similar design, but the collector load here is represented by a high impedance magnetic earpiece in which the signals are heard.

On inject, SW1 is in position 3 and the output of Q2 is coupled to R4, acting as the collector load and also to C3 which feeds back to the base of Q1. The circuit, which was previously an amplifier, now becomes a multivibrator producing a square wave signal at approximately 1kHz and this is fed, again via C1, to the probe.

A square wave can be described as a fundamental frequency plus all its harmonics and so in addition to 1kHz there is an output at 2kHz, 3kHz etc., going right up into the

RF range. In fact, these are still a useable output at 30MHz.

Holding the probe near the aerial will produce an output from a working radio as the injector is working as a very low power transmitter and an output at 1kHz will be heard from the loudspeaker.

High gain transistors are needed in order to hear really low signal sources and high frequency types are needed to handle the upper harmonics.

Note that only high impedance magnetic earpieces are suitable, though 2000 ohms headphones can be used instead.

Once completed and used the signal injector/tracer will be found to be almost indispensable and this reason it is worthwhile building the circuit carefully and neatly into a small chassis.